

Preliminary Study: Short-term Beneficial Effects of Thai Tok Sen Massage on Pain, Pressure Pain Threshold, and Upper Trapezius Muscle Thickness Among People with Shoulder Pain

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Background: Shoulder muscle pain and spasm is the most common problem in people after prolonged working, similar to that resulting from office syndrome. Various medicinal treatments with analgesic drugs, hot packs, therapeutic ultrasound, or deep friction techniques can be clinically applied. Alternatively, traditional Thai massage (TM) with deep compression gentle technique also can help to release that problem. In addition, an traditional Thai treatment with Tok Sen (TS) massage has been generally performed in the Northern part of Thailand without any scientific evidence support. Thus, the aim of this preliminary study was to reveal the scientific value of Tok Sen massage on shoulder muscle pain and upper trapezius muscle thickness among people with shoulder pain.

Materials & Methods: Twenty participants (6 males and 14 females) who suffered from shoulder pain were randomized into TS (n =10, aged 34.2 ± 7.34 yrs) or TM (n=10, aged 32.8 ± 7.24 yrs). Each group received two times 5–10 minutes of treatment, one week apart. At the baseline and after completing two times of each intervention, pain score, pain pressure threshold (PPT), and specific trapezius muscle thickness were evaluated.

Results: Before both TM and TS interventions, pain score, PPT, and muscle thickness were not statistically different between groups. After two times of intervention, pain scores significantly reduced in TM (3.1 ± 0.56; $p = .02$, 2.3 ± 0.48; $p < .001$), as same as in TS (2.3 ± 0.67; $p = .01$, 1.3 ± 0.45; $p < .001$) when compared to baseline.

This was the same as the results of PPT in TM (4.02 ± 0.34; $p = .012$, 4.55 ± 0.42; $p = .001$) and TS (5.67 ± 0.56; $p = .001$, 6.8 ± 0.72; $p < .001$). However, the trapezius muscle thickness reduced significantly after two interventions by TS (10.42 ± 1.04; $p = 0.002$ & 9.73 ± 0.94 mm, $p < .001$), but did not change in TM ($p > .05$). Moreover, when compared between interventions at the first and second periods, TS showed a significant difference in pain score ($p = .01$ & $p < .001$), muscle thickness ($p = .008$ & $p = .001$) as well as PPT ($p < .001$ & $p < .001$) when compared to TM.

Conclusion: Tok Sen massage improves upper trapezius thickness from muscle spasms and reduces pain perception and increases the pressure threshold pain among participants who suffer from shoulder pain similar to that of office syndrome.

KEYWORDS: office syndrome; pain; pressure pain threshold; Thai massage; Tok Sen; upper trapezius thickness

INTRODUCTION

Nowadays, there are many people who are suffering from routine prolonged work. Various symptoms such as muscle spasms, local and referred pain, stiffness on the shoulder, neck, and back, and numbness along the arm are the most common problems among working people.⁽¹⁾ Especially people who experience prolonged sitting in front of a computer desk or computer working longer than 8 hours a day presented with neck and shoulder pain.⁽²⁾ There

are various traditional medical treatments for people who are suffering from office syndrome—for example, Thai massage (TM) and acupuncture.^(3,4) In one study, acupuncture at the neck and shoulder areas among 40 people with office syndrome could reduce pain and increase range of motion of the neck when compared to before treatment.⁽³⁾ Unfortunately, the study design did not recruit a control group; therefore, the clinical benefit is also not completely summarized. Traditional TM has been reported for mainly effects of relaxation,⁽⁵⁾ and showed immediate improvement in the heart rate variability (HRV), pressure pain threshold (PPT), and body flexibility among patients with back pain-associated myofascial trigger points.⁽⁶⁾ In addition, TM also has shown therapeutic effects on pain, muscle tension, and anxiety in patients with myofascial pain syndrome. The review document in 2015 indicated that traditional TM possibly helps in the case of chronic pain.⁽⁷⁾ In addition, the surprising efficacy of using the TM on muscle tension by thumb compression as the same as deep transverse friction massage was reported, with an explanation that these techniques help release the muscle tension, reducing damage and scarring formation.⁽⁸⁾ Thus, TM can be applied to people who are suffering shoulder pain from office syndrome and result in reducing pain, promoting relaxation, and increasing the range of motion. But the benefits of reducing muscle spasm or taut band of chronic muscle contraction from repetitive and prolonged work have not been confirmed.

The surprisingly specific technique of Tok Sen or Wood Hammering has been performed during TM in some parts of Northern Thailand. This technique has been inherited from a gentleman of Lanna Knowledge. From the aspect theory of Tok Sen with Thai traditional theory, Tok Sen has the effect of opening the wind and energy flow in the body.⁽⁹⁾ However, there are no academic reports supporting its claim. A previous report showed that Tok Sen could be applied in conjunction with a Physical Therapy program and showed the clinical benefits in people with office syndrome.⁽¹⁰⁾ The possible mechanism of Tok Sen is an external vibration effect from hammering on the muscle that helps to unbound the myofascial and muscle fibers and release the muscle tension. Unfortunately, this reason cannot be concluded

because of the lack of any scientific evidence support. Therefore, this preliminary study aimed to evaluate the benefits and mechanism of short intervention by Tok Sen on pain score, pressure pain threshold, and muscle thickness of the upper trapezius among participants who were suffering from shoulder pain from office syndrome, compared to Thai massage.

MATERIALS & METHODS

Design

The study design was a simple randomized protocol in the Thai massage (TM) and Tok Sen (TS) groups with gender balance in each group. The study was approved by the Ethics Review Committee for Research Involving Human Subjects, Faculty of Associated Medical Sciences, Chiang Mai University (AMSEC-64EX-103).

Participants

The sample size in this study was based on a previous study⁽⁶⁾ that showed an acute beneficial effect of Thai traditional massage with deep compression technique on pain intensity (evaluated by using a visual analog scale [VAS]) among 10 participants. The sample size estimate was performed by G*Power (3.1.9.2) with the effect size of $d = 0.87$, alpha error prob = 0.05, and power ($1 - \beta$ err prob) = 0.80. Calculation and analysis by the pain intensity result with t test (Means: the difference between two independent groups) was approved at eight persons per group. Prevention of loss at 20% also was calculated and it revealed that two persons per group should be added. Therefore, 10 participants were required in each group. Inclusion criteria were those who presented the symptom of shoulder pain from prolonged working which had lasted longer than two to four weeks, and had at least one local trigger point or taut band on the shoulder muscles. Trigger points were diagnosed as the presence of tender points within palpable taut bands of muscle in areas that the participant identified as painful and possibly referred to the neck or head areas. Excluded criteria included some cervical disorders, such as cervical spondylosis, or herniated disc; neurological disorder such as hemiplegia or paresis; and skin diseases such as herpes zoster; no communicative ability or inability

to follow instructions; a fever of 38.5°C or uncontrolled hypertension. Each participant signed an informed consent form before the baseline examination.

Outcomes

Outcome measurements including the pain score, pressure pain threshold (PPT), and thickness of upper trapezius muscle, which were assessed before and after two interventions. The first and second intervention were performed apart for one week and on the same day. The assessor was a licensed physical therapist and certified and well-trained in ultrasonography practice who was blinded to the group allocation of the participants. During the study for one week, all participants were requested to continue their regular work, but any heavy exercise or activities, or extra supplements were not permitted.

Interventions

Twenty participants who suffered from shoulder pain were randomized into a Thai massage (n = 10) or a Tok Sen group (n= 10).

Thai massage (TM) with a deep compression technique was performed on a specifically affected shoulder in a cross-sitting position on a mat following a previous protocol.⁽¹¹⁾ The therapist had been legally well-trained and certified in the Thai massage course from Thai Traditional and Alternative Medicine, Thailand. The therapist stood behind the participant, moved one leg one step behind, bent the other leg slightly, and performed a deep compression with the thumb on the shoulder blade by two inches apart between points from the medial part of the shoulder tips. The thumb compression force must not exceed the pressure threshold of each participant's feeling. The moving path of the pressure was along the upper trapezius muscle to the side of the C-7 spinous process and return for 10 rounds. Each pressure lasted 10 sec (Figure 1A).

Tok Sen (TS) massage was performed by a therapist who had legally well-trained and certified in the Tok Sen course from Thai Traditional and Alternative Medicine, Thailand. Devices of Tok Sen are composed of a rubber hammer and a wooden round head (7 sq inches of surface area of the head and 7 inches long of the handle). The force and rhythm of Tok Sen along the upper trapezius muscle were applied

with moderate intensity and smoothness by a therapist. Tok Sen was performed along and transverse direction of the upper trapezius muscle to the side of the C-7 spinous process and returned for 10 rounds (Figure 1B).

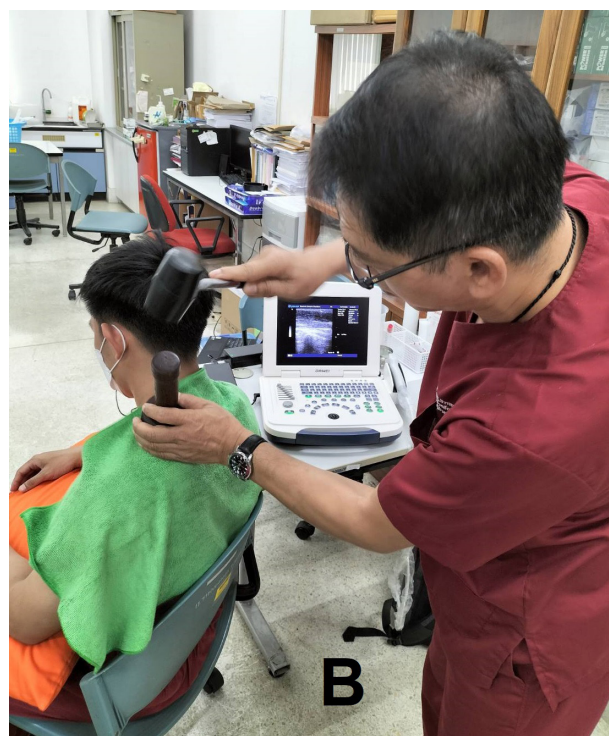


FIGURE 1. Interventions: Thai massage with local deep compression (A) and Tok Sen intervention (B).

Measurements

Pain Sensation & Pressure Pain Threshold (PPT) Evaluation

The pain sensation on the shoulder was evaluated by 10-cm horizontal visual analog scales (VAS), which is a simple tool for measuring perception, rated from 0 (no pain) to 10 (most severe pain). Pain sensation was assessed before and after the completed intervention. The participants were instructed to mark the line indicating their sensation of pain. The reliability of data obtained with VAS is reported to be high ($r = 0.99$)⁽¹²⁾ with high construct validity.⁽¹³⁾

Pressure pain threshold (PPT) of a specific muscle point that showed the most pain and referred pain to the neck or head when manually compressed by thumb by the therapist was evaluated using a Pain Test™ algometer.⁽¹⁴⁾ The participants were requested to give a verbal signal when feeling pain or discomfort. Each trigger point was measured three times and the average was taken for analysis. The results of the pressure measurements were expressed in kilogram (kg). The reliability of measurement was tested at beginning of the study and found high for PPT (ICC = 0.78)

Ultrasonography

Determination of the thickness of the upper trapezius muscle was done following the Adigozali et al. protocol.⁽¹⁵⁾ Participants were required to sit on a chair with forearms supported. The trapezius muscle thickness was evaluated by a well-trained ultrasonographer. A linear probe of ultrasound with the frequency of 9 MHz and Gray-scale B mode was used with an ultrasound machine (DAWEI DW-330; Dawei Medical Co., Ltd, Jiangsu, China) (Fig 2A). The thickness of the upper trapezius muscle presenting a specific taut band and trigger point with referred pain to the neck or head after manual palpation (Figure 2B), was measured as defined as the greatest distance between two hyper-echogenic fascial layers. Ultrasonography was measured before and after complete intervention with Thai massage or Tok Sen.

SPSS software version 11.0 was used for data analysis (IBM SPSS Statistics, Armonk, NY). The distribution of variables was tested with a one-sample Kolmogorov-Smirnov test. Reliability analysis of PPT measurement was performed by Intraclass



FIGURE 2. Ultrasound device (A) and Ultrasonography of upper trapezius muscle (B).

Correlation Coefficient (ICC) with a two-way random-effects model. Independent *t* test and repeated measurement ANOVA between group, intervention, and time were used. Finally, the effect size (Cohen's *d*) and power value of the result between the group was analyzed by a G*Power 3.1 (Germany; <https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower>) to confirm the clinical significant result with

statistically significant and large power of results.

RESULTS

Demographic & Baseline Characteristics

Demographic data and baseline characteristics of the two groups are shown in Table 1. The results of an independent *t* test analysis showed that there was no statistical difference between the groups. Most of all participants in both groups were computer personnel (40%–50%) and suffered from shoulder pain for more than three weeks on average. In addition, most of the participants presented taut band and trigger point of upper trapezius muscle with referred pain (80%–90%).

The results of pain sensation, pressure pain threshold (PPT), and muscle thickness are shown in Table 2. At baseline or

before the intervention, all parameters between groups were not statistically different ($p > .05$). Thai massage (TM) with a deep pressure point on the shoulder blade significantly decreased the pain score after completing the first and second interventions ($p = .02$ & $p < .001$), as same as the TS ($p = .001$ & $p < .001$) when compared to the baseline. The same results of significant difference were also presented in the pressure pain threshold (PPT) in TM ($p = .012$ & $p = .001$) and TS ($p = .001$ & $p < .001$) compared to the baseline values.

Upper trapezius muscle thickness was determined by ultrasonography before and after intervention which was set at 9 MHz, 94 of gain, and Dyn of 104 (Figure 3A & 3B). The result reported in Table 2 shows that TM was not change in thickness after two interventions ($p = .75$ and $p = .41$), whereas TS significantly decreased ($p = .002$ & $p < .001$) when compared to the baseline period. In

TABLE 1. Demographic and Baseline Clinical Characteristics of Participants with Shoulder Pain

Characteristics	Thai Massage	Tok Sen	<i>p</i> ^a
Number of patients	10	10	
<i>Demographic data^b</i>			
Age (yrs)	34.20 ± 7.34 (24–46)	32.80 ± 7.23 (21–45)	.67
Gender (males/females)	3/7	3/7	
Height (m)	1.67 ± 0.05 (1.55–1.75)	1.65 ± 0.08 (1.5–1.8)	.58
Weight (kg)	66.2 ± 7.58 (48–75)	62.4 ± 8.28 (45–69)	.29
BMI (Kg.m ⁻²)	23.70 ± 3.05 (17.6–29.1)	23.00 ± 4.25 (16.6–30.2)	.67
Duration of shoulder pain (wks)	3.10 ± 0.74 (2–4)	3.2 ± 0.63 (3–5)	.75
<i>Occupation, n (%)</i>			
Teacher	2 (20 %)	3 (30 %)	
Secretary	2 (20 %)	1 (10 %)	
Car driving	2 (20 %)	1 (10 %)	
Computer personnel	4 (40 %)	5 (50 %)	
<i>Shoulder pain characteristic</i>			
Trigger point with refer pain	8 (80%)	9 (90%)	
Taut band	2 (20%)	3 (30%)	

^aP value was statistically analyzed by an independent *t* test.

^bData of demographic represented with mean ± standard deviation (SD) (min-max).

TABLE 2. Pain Score, Pressure Pain Threshold, and Muscle Thickness Before and After Two Intervention Sessions

Parameters	Before	Intervention 1	Intervention 2
<i>Pain Score</i>			
Thai massage	4.1 ± 0.56 (3–5)	3.1 ± 0.56 (<i>p</i> = .02) (2–4)	2.3 ± 0.48 (<i>p</i> < .001) (2–3)
Tok Sen	4.3 ± 0.82 (3–5) <i>p</i> = .53 ^b	2.3 ± 0.67 (<i>p</i> = .001) (1–3) <i>p</i> = .01 <i>d</i> ^c = 1.29, Power = 0.82	1.3 ± 0.45 (<i>p</i> < .001) (1–2) <i>p</i> < .001 <i>d</i> = 2.15, Power = 0.84
<i>Pressure Pain Threshold (PTT)</i>			
Thai massage	3.57 ± 0.33 (3.25–4.25)	4.02 ± 0.34 (<i>p</i> = .012) (3.5–4.0)	4.55 ± 0.42 (<i>p</i> = .001) (3.75–4.5)
Tok Sen	3.67 ± 0.52 (3.25–4.5) <i>p</i> = .62	5.67 ± 0.56 (<i>p</i> = .001) (4.5–6.5) <i>p</i> < .001 <i>d</i> = 3.56, Power = 0.89	6.8 ± 0.72 (<i>p</i> < .001) (5.5–7.75) <i>p</i> < .001 <i>d</i> = 3.81, Power = 0.93
<i>Muscle Thickness</i>			
Thai massage	12.35 ± 1.36 (10.83–15.34)	12.11 ± 1.44 (<i>p</i> = .75) (9.99–15.12)	12.04 ± 1.45 (<i>p</i> = .41) (9.87–15.10)
Tok Sen	12.48 ± 1.38 (11.23–15.34) <i>p</i> = .84	10.42 ± 1.04 (<i>p</i> = .002) (9.45–12.23) <i>p</i> = .008 <i>d</i> = 1.34, Power = 0.81	9.73 ± 0.94 (<i>p</i> < .001) (8.45–11.12) <i>p</i> = .001 <i>d</i> = 1.89, Power = 0.83

^aData shows mean ± standard deviation (SD) (min-max).

^b*P* value was statistical analysis with repeat measurement and Tukey’s post-hoc test was used to compare the group and three periods.

^c*d* The effect size and power value was calculated by G*Power 3.1 with independent t test. ^a*P* value was statistically analyzed by an independent t test.

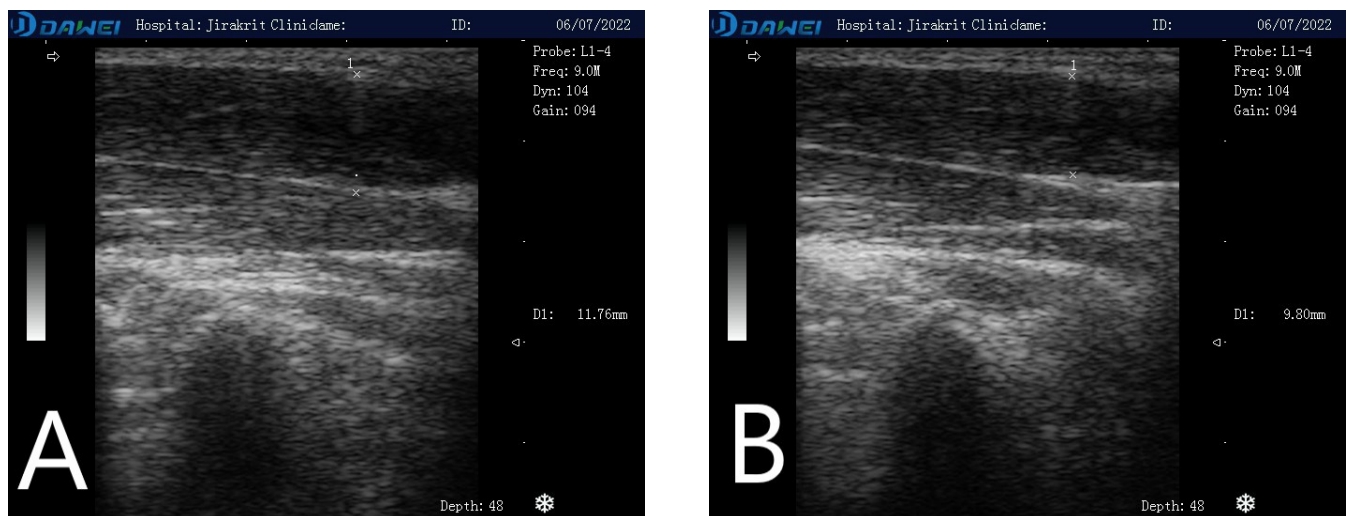


FIGURE 3. Ultrasonography image at 9 MHz, for measurement of upper trapezius muscle thickness before (A) and after completing the first intervention with Tok Sen (B). The vertical distance between two echogenic fascial layers was marked for measurement of upper trapezius thickness. D1 in both figures is a thickness of the upper trapezius muscle that was calculated by ultrasound imaging.

addition, muscle thickness showed significant difference between intervention at the after first intervention ($p = .008$) and second intervention ($p = .001$).

From all results at the first and second intervention periods between TM and TS, each significant value was confirmed with the effect size and power of test. Results showed the effect size (d) and power values were approximately 1.3 and more than 0.8 that indicates the large effect size and high power of test.

Moreover, when compared between the group at each intervention session, TS reduced pain sensation and muscle thickness and increased PPT significantly from TM ($p < .05$). Finally, the effect size and power of the test between the groups in each session in all parameters were more than 0.8, indicating the power and very large effect size.

DISCUSSION

This study showed some interesting results of traditional Thai medicine treatment of Tok Sen that have not been presented anywhere. Most musculoskeletal problems from shoulder and neck pain can be found among many people who have hard work, especially computer users longer than eight hours a day.^(2,16) There are various methods to release these problems; for example, manual therapy with thoracic and cervical mobilization, and stabilization exercises increased pressure pain threshold after six weeks of interventions.⁽¹⁷⁾ There are various traditional medical treatments for people who are suffering from office syndrome; for example, Thai massage (TM) and acupuncture.⁽³⁾ Acupuncture has been proposed to help people who suffer from muscle pain and soreness by using long and thin needles to stimulate nerves in the muscle, especially in which the trigger point was present.⁽¹⁸⁾ Endorphin-releasing mechanism is claimed to be of help in reducing pain and gaining a range of motion in a previous study.⁽³⁾

Previous evidence showed that traditional TM has a relaxation effect,⁽⁵⁾ and showed immediate improvement in pressure pain threshold (PPT) and body flexibility among patients with back pain-associated myofascial trigger points.⁽⁶⁾ In addition, TM also has therapeutic effects on pain and muscle tension among patients with myofascial pain syndrome. Thus, the review document

in 2015 indicated that traditional TM possibly helps in the case of chronic pain.⁽⁷⁾ The beneficial effect of TM is depended on the severity or stage of pain, but some evidence showed that it could reduce pain after one session of classic TM in chronic neck pain.⁽¹⁹⁾

Although Thai massage or classic Thai massage has a regular pattern and many techniques, deep compression by the thumb's therapist on the shoulder blade was performed in this study. Interesting results of this study showed positive results on reduce pain sensation and pressure pain threshold (PPT) after two interventions of TM. However, the clinical effect of deep tissue massage or deep compression technique on shoulder pain has not been previously studied. Thus, the beneficial effect specifically of this technique can be explained by releasing the muscle tension, and reducing damage and scar formation as in a previous suggestion.⁽⁸⁾ Moreover, the deep compression technique in TM is similar to deep tissue massage therapy.⁽²⁰⁾

The interesting question on the beneficial effect of Tok Sen massage on muscle pain has not been explained, and the proposed theory of Tok Sen opening the wind and energy flow has not been proved.⁽⁹⁾ But it was applied to the Physical Therapy program and showed acute clinical benefits in a person with office syndrome.⁽¹⁰⁾ Its mechanism possibly is like an external vibration effect on the muscle fibers and helps to release the muscle tension. This is similar to the shockwave therapy that has been reported for reducing contractile activity, decreasing muscle tone and spasm, and also eliminating trigger points.⁽²¹⁾ It has been used as treatment in various conditions such as tendinopathies,⁽²²⁾ plantar fasciitis,⁽²³⁾ and calcific tendinitis of the shoulder.⁽²⁴⁾ Some evidence documented that 12 weeks of shockwave treatment can stimulate the early expression of angiogenesis-related growth factors, induces the ingrowth of neovascularization, and increase cell proliferation and tissue regeneration to repair tendon or bone tissues in an animal study.⁽²⁵⁾ Previous evidence showed that shockwave therapy on trapezius muscle with a total of 240 waves, a low energy flux density (EFD) of 0.10 mJ/mm² per minute for three times a week reduced pain among people who have myofascial pain syndrome in the trapezius muscle.⁽²⁶⁾ But

there is no evidence of a beneficial effect of shockwave on muscle thickness.

Unfortunately, the intensity and rhythm of Tok Sen have not been reported, but the gentle force and direct contact along the muscle alignment covering the signal points and energy flow of the meridian line in the body was followed using a Thai traditional medicine guideline.⁽²⁷⁾ The vibration phenomenon of hammering is applied directly into the muscle fiber to release the tension. In addition, the intensity of Tok Sen was determined under the maximal individual pain threshold on the muscle of participants. The mechanism of Tok Sen to reduce pain sensation and increase the pressure pain threshold can be explained by a nociceptive processing pain pathway,⁽²⁸⁾ by relaxing at the end-plate zones⁽²⁹⁾ and desensitized nerve fiber of taut band.⁽³⁰⁾ In addition, the significant change in pain sensation and pressure pain threshold was a short period of two interventions for both TM and TS, that quickly responded. Other studies presented longer periods; for example, six weeks of stretching exercise⁽¹⁷⁾ or 9 sessions of acupressure in muscle cramps.⁽³¹⁾ This may be a different treatment.

Finally, the effect of Thai massage and Tok Sen on upper trapezius muscle thickness was interesting in this study. A previous report recommended that the various factors on muscle thickness were gender, BMI, and age. For example, the man had thicker muscles than the woman.⁽³²⁾ People who are obese or have high BMI showed higher muscle volume than thin persons.⁽³³⁾ In addition, previous data showed age-related decreases in muscle thickness.⁽³⁴⁾ The thickness of trapezius muscle among people who suffered from myofascial pain syndrome was associated with pressure pain threshold and pain.⁽³⁵⁾ From this study, the baseline of characteristics between groups showed no statistical difference. Thus, gender, BMI, and age have not affected the baseline thickness. Most participants had the taut band in the trapezius muscles from palpation, but specific hyperechogenic visualization in ultrasonography was not presented. Some evidence suggested that the taut band can be observed in ultrasonography with a hyperechogenic pattern.⁽³⁶⁾ A taut band is suggested for a local twitch response or transient muscle contraction that showed more muscle thickness.⁽³⁷⁾ Ultrasound imaging or ultra-

sonography is non-invasive and a quality assessment tool for evaluating muscle thickness, and showed good reliability and validity.⁽³⁸⁾ This tool has been studied in various conditions, for example, upper trapezius muscle in myofascial pain syndrome,⁽³⁹⁾ and sarcopenia.⁽⁴⁰⁾ Therefore, ultrasonography was used to compare the effect of Thai massage and Tok Sen on the upper trapezius muscle. The result showed a significant reduction of thickness after Tok Sen intervention the first and second times. Therefore, it can be possibly explained as the mechanical vibration effect of hammering to enhance the viscoelastic property. But this study did not confirm the viscoelastic properties of the upper trapezius muscle either before or after interventions. That can be evaluated by ultrasound elastography⁽⁴¹⁾ in the future.

From the significant difference in each parameter, results may not be exactly concluded because of the low sample size in each group (n=10). The statistical significance should be confirmed with effect size (Cohen's *d*) and the power of the result. Effect size and power of more than 0.8 has been preferred.⁽⁴²⁾ The results of effect size (Cohen's *d*) analysis in Table 2 is more than 0.8 when compared between the groups. This result indicates the large ES and very large power related to the significant value in the case of a small sample size of this study.⁽⁴³⁾ In addition, the power value in each parameter can be useful to predict the sample size in the next study, and the result of the G*Power program showed that 10 participants in each group also can be used for future studies.

CONCLUSION, LIMITATIONS & SUGGESTIONS

This preliminary study shows that a short time of Tok Sen intervention has benefits on pain sensation and pressure pain threshold, and also can reduce the trapezius muscle thickness among participants with shoulder pain caused by office syndrome. But, the exact mechanism of Tok Sen on trapezius muscle also cannot be confirmed, especially on the viscoelastic property and other mechanisms for reducing pain sensation. Moreover, the beneficial effect of Tok Sen on other conditions, such as tendinitis and muscle cramp, for example, and on a larger sample size should be studied in the future.

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CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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